UNITED STATES HOP INDUSTRY AND THE VOLUME CONTROL PROVISIONS OF THE UNITED STATES FEDERAL HOP MARKETING ORDER

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The U.S. Hop Industry and the Volume Control Provision of the U.S. Federal Hop Marketing Order

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Hop marketing is characterized by a number of features that make the agricultural commodity unique. First of all, specific quantities at specific prices are contracted for as long as 7 years in advance. For example, in October, 1980, only 1% of the 1980 crop, 1%-2% for 1981, 1%-2% for 1982, 15%-20% for 1983, 45% for 1984, 55%-60% for 1985, and 80% of the 1986 and 1987 crops remained for sale (16, Nov. 17, 1980). Second, the demand for hops by brewers is inelastic. This is caused by the reluctance of brewers to change significantly the quantity of hops used per barrel of beer in order to maintain a consistent taste and character of their beer. Third, and related to the second, there is no substitute for hops as far as brewers are concerned, and there is no significant alternative use for hops except for beer production in their view. Fourth, hops represent a very small portion of the finished product for which they are used, where 1 pound of hops will flavor over 1,300 12-ounce bottles of beer.[1] Fifth, hops are a perennial crop with high capital investment requirements, where field trellising systems and processing facilities (drying and baling equipment) must be purchased by the grower. Lastly, the production and processing costs per acre are high. The 1977 estimated total costs per acre (cash and noncash) with an 1,800 pound yield per acre were $1,819.09 or $1.01 per pound. Of the estimated total cost, 55% were annual overhead costs [2].

The grower supply response for hops, as is true for all raw agricultural commodities, is lagged such that considerable time passes between when a decision is made to produce, and when production actually takes place. Coupling of the lagged supply response of hops with the commodity characteristics listed above resulted in 11 full cycles in hop acreage from 1915 to 1980 (18). The average cycle during this period was 6 to 10 years in duration, with an average of 3 to 5 years each on the upward and downward side. The more recent cycles have become longer in total duration, with the downward side of the cycles lasting longer than the upward side.

Table 1. Statistical measures of central tendency and dispersion of U.S. hop acreage, production, and price, 1915-80.

Item	STATISTICAL MEASURES		
	Mean	Standard deviation	Coefficient of variation
Acreage (acres)	29,973.1	7,087.7	23.68%
Production (1,000 lb)	43,518.7	11,872.7	28.28%
Seasonal average price (¢/lb)	45.7	26.8	58.6%

The cyclical nature of hop acreage, together with an inelastic demand structure for hops [3] would seem to encourage a great deal of hop price variation. The mean, standard deviation, and coefficient of variation for the acreage, production, and seasonal average price for hops from 1915 to 1980 are reported in table 1. The coefficients of variation reveal that the seasonal average price has had over twice the variation compared to the acreage or production levels.

The economic condition of the U.S. hop industry led to the formation of federal marketing orders in 1938, 1949, and 1966. The major objective of each of these marketing orders was to improve the returns to growers through orderly marketing.[2]

Both the 1938 marketing order (which was terminated during World War II) and the 1949 marketing order regulated the disposition of hop production in a given year. Specifically, each year following harvest every producer received and could market an allotment representing

[1]Personal communication with Mr. Robert H. Eaton, Manager, U. S. Hop Administrative Committee.

[2]Orderly marketing can be defined as the coordination of total supply of a commodity over time, form, and spatial markets, in such a way as to achieve sellers' market objectives (10, p. 597). In spirit with the enabling legislation of the Agricultural Marketing Agreement Act of 1937 and all amendments, it is possible for fruit, vegetables, and nut federal marketing agreements and orders to use one or some combination of activities to achieve an orderly marketing program and increase grower returns. These activities or provisions of a marketing order may include (1) grade, (2) size, (3) pack and container, (4) flow to market, (5) market allocation, (6) reserve pool, (7) producer allotments, (8) research and development, and (9) advertising (promotion).

a pro rata share of the crop for that particular year. The program contained no provision to influence the hop production response, so that in the following year old and new growers alike were free to grow as much as they wished. The 1949 marketing order was not successful in influencing the production response. The production response was large enough so that surplus set aside percentages increased from 12% in 1949 to over 30% in 1951. When it appeared that set aside could be as high as 50% in 1952, growers voted out the marketing order on the grounds that the cost of producing the surplus more than offset the benefits resulting from the higher price on the quantity of hops that were salable.[3]

The present hop marketing order (Order No. 991) came into effect in 1966 and stipulated that each grower was to receive a permanent "allotment base" or "base quota" based on the average quantity the grower actually sold during 1962 through 1965. The Hop Administrative Committee[4] (HAC) announces the percentage of the base that is salable in any given year, and this is referred to as salable quantity. Hop growers can then market directly from the production of that year a quantity of hops equal to the announced percentage of base. All hops produced in excess of a grower's salable quantity can only be marketed through the reserve pool which is managed by the HAC.

The salable quantity decision utilizes relevant supply and demand considerations for the marketing year in which it will have an effect. The decision is made in January and applies to the ensuing marketing year which begins on the following September 1. Thus, much of the information on which the salable quantity decision is based is estimated on projected levels of demands and supplies. A more thorough examination of the operations of the Federal Order and the HAC will follow in subsequent sections.

Volume control provisions, such as the one in the hop market order, have been among the most controversial aspects of all marketing order provisions. Consumer advocates, members of the Federal Trade Commission, the Department of Justice, and political parties are becoming increasingly concerned about such provisions. One concern is that marketing orders can be used to create more than an orderly market program, i.e., there is concern that the quantity can be restricted enough to lead to undue price enhancement by exercising monopolistic power obtained with government sanction.[5] The problems are particularly complex with perennial crops, such as hops, where production cycles occur. With hops only a partial crop is obtained the first year (baby hops) with full production being obtained in the second year.

The research reported herein deals with the U.S. hop industry during the 1952-80 period with special emphasis on the 1969-80 period. It focuses mainly on the behavior of the marketing order's administrative committee (HAC) in determining the salable quantity for each marketing year. HAC behavior is analyzed statistically and the HAC decision process is modeled. The main purpose of the research is to evaluate the responsiveness of the HAC to market signals in the determination of the salable percentage that is computed each year.

Production and Demand Characteristics

Production

There are more than 20 hop producing countries in the world, but, the bulk of hop production takes place in only a few. The five leading countries in hop production accounted for approximately 80% of the world's hop production from 1978 through 1980 (table 2).

International trade in hops is significant. U.S. imports of hops or hop extract has ranged from 10.4 to 16.8 million pounds of hops from 1974 to 1980. These imports were primarily from West Germany, Yugoslavia, Czechoslavakia, and Poland. During the same time period, U.S. exports ranged from 25.1 to 41.7 million pounds of hops. The primary buyers of U.S. hops were Brazil, Mexico, U.S.S.R., Canada, Columbia, Japan, Ireland, and West Germany.

The United States, West Germany, and Czechoslavakia, listed in order of importance, account for approximately 85% of the hops exported and traded on world markets. The production of the U.S.S.R. and United Kingdom are almost entirely consumed domestically.

World trade patterns in hops are dictated mostly by economic and political forces (for example, there was a temporary embargo of hop shipments to the U.S.S.R. in January, 1980). In addition, brewing[6] philosophies in each country impact trade patterns. The two major brewing philosophies are: (1) the tra-

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[3]Personal communication with Mr. Robert H. Eaton.

[4]All marketing order programs for fruits, vegetables, and specialty crops have administrative committees composed mostly of producers who work with the USDA in carrying out the provisions of the orders.

[5]A partial measure of price enhancement would be the annual leasing or fees charged for use of the allotment in relation to the average price received. In 1980, the common fee charged for the annual use of allotment was $.15 per pound. This represents only 10% of the average 1980 price of $1.50 per pound. With 1980 hopping ratio being slightly over 0.2 pounds of hops per 31 gallons of beer, the maximum price enhancement that could have occurred was less than $0.000085 per 12 ounces of beer.

There is not a consistent series on such annual leasing fees, and thus, the behavior of this administrative committee (HAC) in relation to the volume control provision was analzed in relation to any monopolistic actions rather than attempting to estimate directly if and how much price enhancement might have occurred during the marketing order.

[6]Hops are primarily used in beer production. A few hops are used for pharmaceutical purposes and perfume.

Table 2. Hop production in selected countries and for the world, 1978-80 (Zintners*).

Country	PRODUCTION 1978	1979	1980
West Germany	606,602	624,202	537,000
United States	499,600	498,313	685,476
U.S.S.R.	220,000	255,000	250,000
Czechoslovakia	201,757	236,265	210,000
United Kingdom	187,374	206,509	190,000
Other countries	448,393	523,909	477,524
World	2,163,726	2,344,198	2,350,000

*Zinter = 50 kilograms.
Source: U.S. Hop Administrative Committee, *Basic Hop Statistics*, Portland, 1981.

Table 3. State Acreages* of hops by type in the U.S., 1980 (acres).

State	HOP TYPE Primarily milder aroma type	Primarily bitter or nonaroma type	Total
Washington	3,740	23,172	26,912
Oregon	3,583	2,596	6,179
Idaho	745	2,069	2,814
California	0	1,166	1,166
Total	8,068	29,003	37,071
Percentage	21.8%	78.2%	

*Strung for harvest.
Source: U.S. Hop Administrative Committee, *Basic Hop Statistics*, Portland, 1981.

Table 4. Acreage of hops by state in the U.S., 1975-81 (acres).

Year	STATE Washington	Oregon	Idaho	California	Total U.S.
1975	21,603	5,612	3,709	1,535	32,468
1976	21,077	5,438	2,979	1,509	31,003
1977	20,707	5,480	2,912	1,508	30,607
1978	21,341	5,471	2,671	1,466	30,949
1979	22,325	5,648	2,731	1,148	31,852
1980	26,912	6,179	2,814	1,166	37,071
1981	31,412	7,191	3,427	1,166	43,196

Source: U.S. Hop Administrative Committee, *Basic Hop Statistics*, Portland, 1981.

ditional philosophy which places emphasis on aroma-type hops which are the varieties mild in flavor, aroma, color, and appearance; and (2) a brewing philosophy which places more emphasis on the alpha acid (bittering) content and less on the hop variety, flavor, and aroma.

Historically, the high alpha acid varities have been produced in the United States.[7] Of the 1980 acreage, 22% were hops of the aroma type (table 3). The remaining 78% were of the nonaroma, bitter, or higher alpha acid-type varieties.

U.S. hops are grown in only four states (table 4). Approximately 66% are grown in the Yakima Valley of Washington, 17% in the Willamette Valley of Oregon, 12% in Western Idaho, and 5% near Sacramento, California. The growth that has occurred in the U.S. hop industry has been primarily in Washington, and, to a lesser degree, in Oregon. Between 1975 and 1980, the hop acreage in Washington increased 5,309 acres. The only other state experiencing significant growth in its hop acreage was Oregon where the acreage increased 558 acres during the 1975-80 period. In Idaho and California the hop acreage declined during the same period. A substantial increase in acreage occurred in 1981, with Washington increasing by 4,500 acres, followed by 1,012 acres for Oregon and 613 acres for Idaho (table 4).

With the increase in hop acreage between 1975 and 1981, there was also an increase in the number of hop producers. In 1975, there were 210 hop producers in the United States. The number of hop producers decreased to 192 in 1979, but are estimated to be 237 in 1981. Overall, from 1970 through 1981, the number of hop producers fluctuated from the low of 192 to the high of 237. The number of hop producers has remained fairly constant with a tendency for their numbers to increase in recent years. Anyone can enter

[7]The varieties considered to be medium to high in alpha acid are Clusters, Talisman, English, Comets, Galena, and Eroica. The lower alpha and aroma varieties include Cascade, Fuggles, Hallerton M.F., and Tettnang.

the hop industry to produce and market the hops by either obtaining base via purchase or lease or by marketing the hops through the reserve pool established under the marketing order. The trend in the number of hop producers is in contrast to the rest of U.S. agriculture where the general trend in number of producers has been downward.

Demand

The demand for hops is a derived demand. Hops are used in the malted beverage industry as a flavoring agent. Domestic malt beverage consumption has increased at a fairly constant rate, while brewery consumption of hops has been far less stable (figure 1). This instability can be partially explained by fluctuations in both brewery stocks and the hopping ratio (the hopping ratio is the pounds of hops used per barrel of beer). Until 1976, the general tendency had been downward in brewery consumption of hops relative to malted beverage consumption. In fact, from 1952 to 1960, when malted beverage consumption was quite stable, brewery consumption of hops was decreasing. The hopping ratio declined steadily from 0.385 in 1952 to 0.200 in 1976 but has increased steadily since 1976 (figure 2).

There is no consensus on the cause of the observed decline in the hopping ratio from 1952 to 1976. One of the primary determinants of flavor in brewing is the variety, quality, and quantity of hops used in the brewing process. This would indicate that the brewers' philosophy over time has gradually changed. Several writers have hypothesized that the decline has been caused by a change in basic consumer tastes toward a beer with paler and milder flavor. Edwards (4) presents an alternate viewpoint where he suggests that the decline in hop demand and subsequent changes in the final product that occur have been imposed on the market by an imperfectly competitive brewing industry, and not by the desire of consumers. Another factor that could have contributed to the hopping ratio decline is the more efficient use of hops in the new breweries together with the trend toward the use of the hops in pellet and extract form—a more efficient form of hops both in terms of beer production as well as for hop storage.

The trend in the hopping ratio has reversed in the past 4 years. One reason for the reversal is the increasing share of the market being captured by light or low calorie beers. As the carbohydrates are being removed to reduce calories, most brewers are finding it desirable to increase the percentage of low alpha, aroma-type hops to give the beer more body or character. If the use of higher alpha varieties is increased, the bitterness becomes too harsh (Eaton, 1978).

Another factor leading to the reversal of a falling hopping ratio is the increasing share of the U.S. market being taken over by the premium and super-premium brands. For this type of malted beverage,

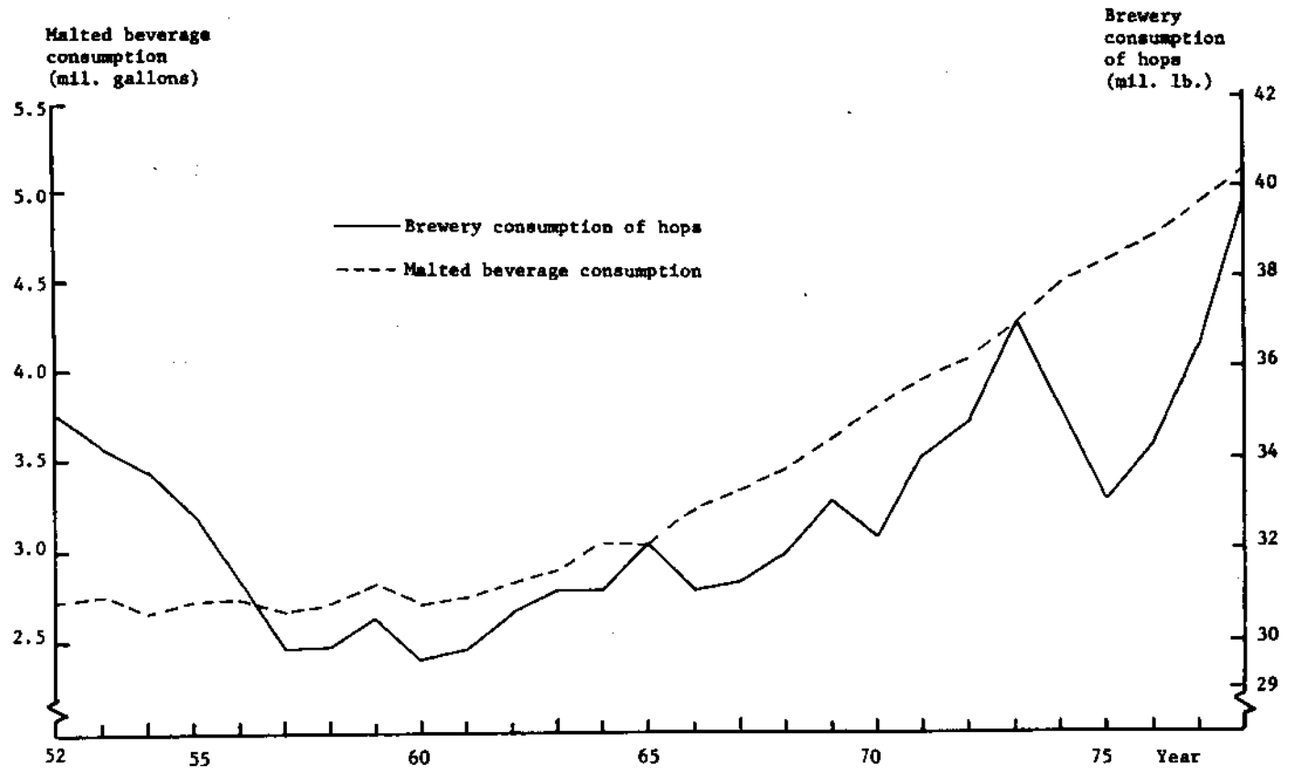

Figure 1. Consumption of malted beverages and brewery consumption of hops in the U.S., 1952-78.

ADAPTED FROM: U.S. Brewers Association, Inc., The Brewing Industry in the United States: Brewers Almanac.

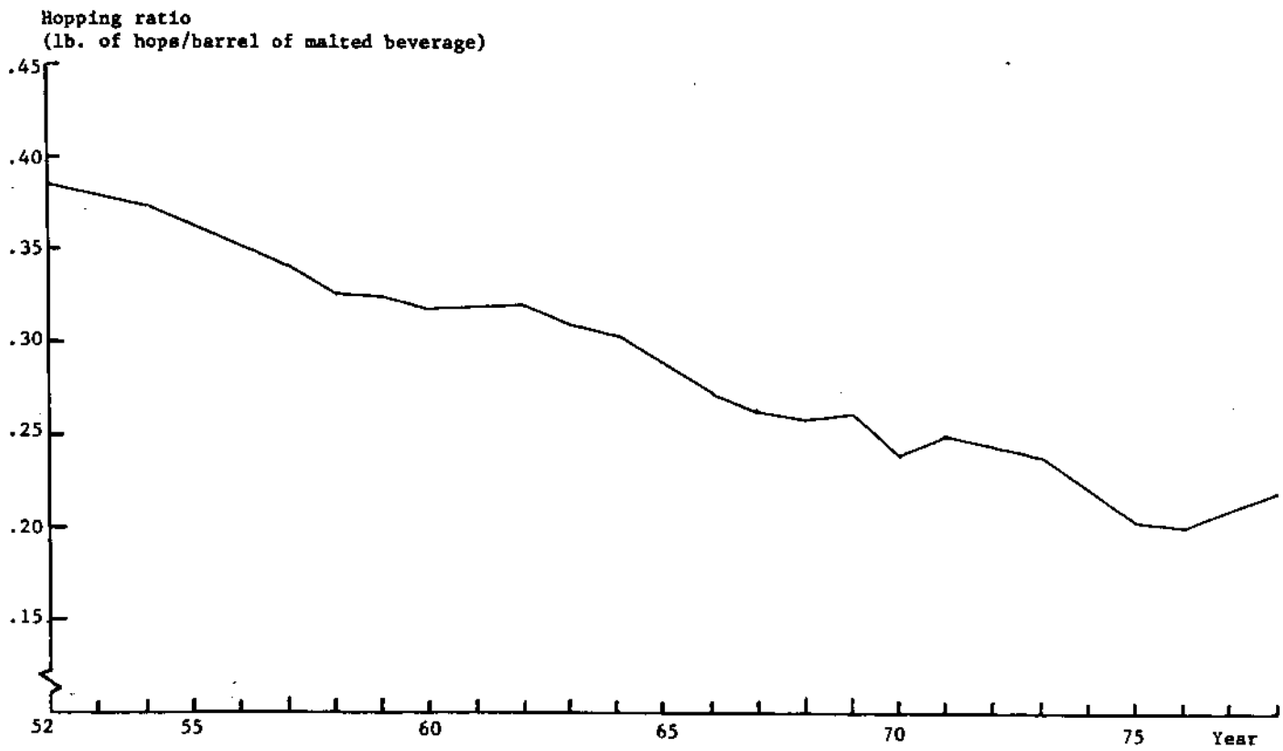

Figure 2. Hopping ratio in the U.S., 1952-78.

ADAPTED FROM: U.S. Hop Administrative Committee, Basic Hop Statistics, various issues.

brewers use primarily aroma-type varieties which are associated with a higher hopping ratio (Eaton, 1978).

The U.S. Hop Marketing Order

Provisions

On July 7, 1966, Federal Marketing Order No. 991 was approved by slightly more than the required two-thirds majority of U. S. hop producers. The order was established to create a more orderly marketing process for hops. It came into effect for the 1966-1967 marketing year.

The order grouped the production areas into four districts, each composed of one producing state. Thirteen growers from these districts comprise the Hop Administrative Committee (HAC), where seven growers are from Washington State, and two each reside in the remaining three states.[8] The main duties of the HAC are to administer the terms and provisions of the marketing order including the reporting of any violation thereof to the Secretary of Agriculture. The HAC also recommends amendments of the order to the Secretary of Agriculture when it is deemed appropriate.

Four main provisions compose the foundation of the marketing order. First is the quality control provision which mandates that only hops meeting a minimum leaf and stem content inspected by a federal-state inspection service can be marketed (Federal Register, 1966). There are no standards for other quality factors such as alpha acid content, aroma, color, and appearance because each brewer has individual preferences and standards. Second, the HAC can undertake research and development projects. Industry funds may be allocated by the HAC to conduct programs that will improve the production, marketing, and distribution of hops (Federal Register, 1966).

The third provision of the order concerns volume limitations. Prior to March 1 of each year, the HAC and the HAB[9] hold joint meetings to adopt a marketing policy for the ensuing marketing year beginning the following September 1. The HAC decides the quantity of hops to be marketed in the upcoming market-year from that year's production. Their

[8]Positions 1 and 2 are for cooperative producers in District 1 (Washington). Positions 3 through 7 are for independent producers in District 1. Positions 8 and 9 are for District 2 (Oregon) producers; 10 and 11 are for District 3 (Idaho) producers; 12 and 13 are for District 4 (California) producers. As of January, 1979, a public consultant was added to the HAC.

[9]The Handlers Advisory Board (HAB) consists of five handlers (dealers) who are elected by all the handlers and acts in an advisory manner to the HAC.

decision is based on the quantity of hops required to establish orderly marketing conditions. Taken into consideration are: (1) prospective stock carryins; (2) desirable stock carryout; (3) prospective imports and exports; (4) anticipated consumption; and (5) any other relevant factors that affect marketing conditions (Federal Register, 1966). The committee then recommends a salable quantity and allotment (salable) percentage to the Secretary of Agriculture who may or may not approve the recommendation.

The salable percentage is equal to the aggregate salable quantiy divided by the total quantity of all producer allotment bases established in 1966 (59,270,000 pounds).[10] The committee, with the approval of the Secretary of Agriculture, can increase, but not decrease, the salable quantity if it deems it necessary due to changing marketing conditions. Increases in the salable quantity can be considered any time after March 1, and in fact, a review of the need for such an increase must occur before August 1 (Federal Register, 1966). The salable quantity is then allocated among producers by applying the salable percentage to each producer's allotment base. Producers may transfer their annual allotment from one location to another. Also, producers may transfer all or part of an allotment base from themselves to another producer.

Additional allotment bases can be granted if deemed necessary by the HAC. If producers should produce less than their annual allotment, they may purchase deficit hops from producers that are in excess.[11] This must be done prior to November 1, the date set when excess hops become reserve hops, unless such date is extended by the HAC. The HAC acts as a clearinghouse of information for producers with either a deficit or an excess (Federal Register, 1966).

The fourth provision of the order provides for a reserve pool. Hops in excess of the annual allotment (following November 1) may be delivered to the HAC and become part of the reserve pool for that year. The grower also has the option of not harvesting reserve hops or keeping them on the farm. If the producer does the latter, however, no handler may purchase them until the order is terminated. As a practical matter, therefore, growers put their reserve hops in the pool. Reserve hops are kept separate by year, variety, quality, and relative value. The reserve hops are marketed by the manager of the order under a policy established by HAC. The policy in recent years has been to market them at the market price or the previous season average price, whichever is higher. If they do not sell at either of these prices they are held for several years and ultimately disposed of at a salvage price in the small package market for home brew or use as yeast in countries such as India and Africa. All reserve pools have sold at prices (undeflated) in excess of the previous year's season average price except the 1974, 1975, and 1976 pools which sold approximately at a salvage price of $.25 per pound. Most growers attempt to tailor their production to their allotment or else market any excess under the deficiency procedure authorized in the last 2 years. Over the years, therefore, a relatively small portion of the crop has been marketed through the pool. The proceeds from the disposition of reserve hops are distributed on a pro rata basis to the respective equity holders on the basis of quality, quantity, and variety. Any expenses incurred by the HAC in receiving, handling, holding, and disposing of the hops in the pool are deducted prior to disposition of pool proceeds (Federal Register, 1966).

HAC Marketing Policy Meetings

In January of each year,[12] the joint HAC/HAB Marketing Policy Meeting is held. The objective of the meeting is to establish a salable quantity, as well as other marketing policy guidelines, for the forthcoming marketing year. The HAB is only advisory to the HAC concerning HAC decisions. The following discussion of the procedures used by the HAC to arrive at the salable quantity will frequently make reference to various time periods (table 5). The hop marketing year extends from September 1 to the following August 31 inclusive. The letter "t" represents the next marketing year in sequence, i.e., the marketing year for which a salable quantity is to be determined. The symbol "t-1" represents the present marketing year, which is approximately half over at the time of the January meeting. The symbol "t-2" represents the last fully completed marketing year. In table 6, the alphanumeric characters with hats ($\wedge$) represent statistics for which projections are made at the policy meeting. Those without hats represent statistics with known values.

At the policy meeting, a worksheet is used in which he salable quantity is determined (table 6). All the market statistics relating to supply and demand components are known for year t-2. The only statistics known for t-1 are the carryin stocks (CI_{t-1}) and the salable production (SPR_{t-1}). The other supply and demand components in the marketing

[10]The salable quantity was set for the first 3 marketing years at the time the hop marketing order was established in 1966.

[11]If the HAC determines that a bona fide effort was not made to produce the annual allotment, a producer may lose the individual base allotment. A bona fide effort clause is written into the Hop Marketing Order. To retain an allotment base, each producer must make a bona fide effort to produce that allotment base. If the producer is not in a position to expand production to comply, the producer can comply by transferring away excess base to another grower, which is generally what occurs rather than the producer losing base. These transfers accomplish the objective of placing the base in the hands of those who can use it.

[12]In 1979 and 1980 the policy meeting was moved forward 3 months to be held in October. The policy meeting for the 1981-1982 year, however, was moved back to January 1982.

Table 5. Time framework in U.S. hop industry.

Occurrences	t-2 Marketing Year				t-1 Marketing Year												t Marketing Year	
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan[a]	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
HAC/HAB quarterly meetings			X			X			X			X			X			X
Harvest				X	X											X	X	
Market Information known at the January, t-1, market policy meeting	All information for marketing year t-2				9/1 stocks; 9/1-11/1 imports, exports, & brewery consumption		11/1 stocks		Quantity not available[b]									
Projections made by HAC/HAB									Updated projections for t-1. Projections for t									

[a]Joint HAC/HAB marketing policy meeting.

[b]Quantity not available due to nonsalable hops (production above salable percentage), fire loss, and differences between last USDA crop production estimate and current market order production records based on bale weights when delivered.

year t-1 are not known and are estimated.

The salable production (SPR_{t-1}) is known since the t-1 harvest was completed the preceding August and September (table 5). Projections are made for the following items: imports ($\widehat{IM}_{t-1}$); brewery consumption ($\widehat{BC}_{t-1}$) exports ($\widehat{EX}_{t-1}$); and balancing item ($\widehat{BI}_{t-1}$). Total supply ($\widehat{TS}_{t-1}$) and total demand ($\widehat{TD}_{t-1}$) projections are then made by summing their respective components.

The projections of the supply and demand components for year t are made after the projections for year t-1 are finalized. The first estimated variable in marketing year t is carryin in t or carryout from t-1 ($\widehat{CI}_t$). It is computed as:

[1] $\widehat{CI}_t = \widehat{TS}_{t-1} - \widehat{TD}_{t-1}$

The other supply and demand components estimated are: imports ($\widehat{IM}_t$); brewery consumption ($\widehat{BC}_t$); exports ($\widehat{EX}_t$); balancing item ($\widehat{BI}_t$); and desirable carryout ($\widehat{CO}_t$). The following discussion describes the factors influencing the HAC in the estimation process.[12]

Expected imports ($\widehat{IM}_t$) are projected by taking into consideration the following factors: estimated imports ($\widehat{IM}_{t-1}$), import trends over past years, the quantity of previously contracted imports, currency exchange rates, breweries' philosophies, domestic and foreign hop stocks, and expected foreign hop crops.

Brewery consumption ($\widehat{BC}_t$) is estimated with the following factors influencing the estimate: estimates of brewery consumption ($\widehat{BC}_{t-1}$), trends in brewery consumption (which include such things as the hopping ratio levels), breweries' philosophies and the form of hop used, brewery stocks, and total U.S. beer production.

Exports ($\widehat{EX}_t$) are estimated by taking the following factors into account: projections of exports ($\widehat{EX}_{t-1}$), export trends over past years, the quantity of previously contracted exports, currency exchange rates, domestic and foreign stocks, world brewing philosophy, and expected hop crops.

The balancing item ($\widehat{BI}_t$) is based on revised projections of $\widehat{BI}_{t-1}$ and the average of the past few years' projections. The main components of the balancing item include minor uses of hops in pharmaceuticals or as a perfume base, and year-end statistical adjustments. The statistical adjustments are due, first, to the loss in weight that occurs when converting hops into pellets. This occurs because pellets are reported on a pound-for-pound basis, the same as fresh or baled hops by the Bureau of Customs for both the imports and exports as well as by domestic brewers in reporting to the Treasury Department. Second, and for similar reasons, statistical adjustments are required due to the extract conversion factor of pounds of fresh hops per pound of hop extract. The balancing item is a component which allows the HAC to use the balance sheet approach to balance supply and demand.

Desirable carryout ($\widehat{CO}_t$) is projected by considering the following factors: projections of carryin ($\widehat{CI}_t$), past year's actual carryout and its effect upon the market, present brewery inventories, brewers' philosophy concerning level of stocks, and the amount of hops necessary in case of crop failure in t+1 to have a sufficient supply.

When all of the above projections have been made, total net supply (TNS_t) and total demand (TD_t) are defined as:

[2] $\widehat{TNS}_t = \widehat{CI}_t + \widehat{IM}_t$

[3] $\widehat{TD}_t = \widehat{BC}_t + \widehat{EX}_t + \widehat{BI}_t + \widehat{CO}_t$

Gross trade requirement ($\widehat{GTR}_t$) is then computed as:

[4] $\widehat{GTR}_t = \widehat{TD}_t - \widehat{TNS}_t$

[12]These factors were determined by direct consultation with members of the HAC.

A special Fuggle allotment (SFA_t) is then subtracted from the $\hat{GTR}_t$. The SFA_t began in 1972 when growers received a 1 million pound allotment exclusively for the production of Fuggle hops, a low alpha-type hop. It has remained unchanged since that time.

A variable entitled "potential available not produced" ($\hat{PANP}_t$) is also added to the $\hat{GTR}_t$. This adjustment depends on the $\hat{GTR}_t$ that was determined and is often computed as a percentage of $\hat{GTR}_t$.

Table 6. Marketing policy work table.

Supply and demand components	Statistics year t-2	Statistics year t-1[a] HAC
Supply		
1. Carryin 9/1	CI_{t-2}	CI_{t-1}
2. Salable production[b]	SPR_{t-2}	SPR_{t-1}
3. Imports	IM_{t-2}	$\hat{IM}_{t-1}$[c]
4. Total supply	TS_{t-2}	$\hat{TS}_{t-1}$
Disposition		
5. Brewery consumption[d]	BC_{t-2}	$\hat{BC}_{t-1}$
6. Exports[d]	EX_{t-2}	$\hat{EX}_{t-1}$
7. Balancing item[e]	BI_{t-2}	$\hat{BI}_{t-1}$
8. Total demand	TD_{t-2}	$\hat{TD}_{t-1}$

	Actual year t-1	Projections year t HAC
Supply		
9. Carryin 9/1	CI_{t-1}	$\hat{CI}_t$
10. Imports		$\hat{IM}_t$
11. Total supply		$\hat{TNS}_t$
Disposition		
12. Brewery consumption		$\hat{BC}_t$
13. Exports		$\hat{EX}_t$
14. Balancing item		$\hat{BI}_t$
15. Desirable carryout[f]		$\hat{CO}_t$
16. Total demand		$\hat{TD}_t$
Salable Quantity		
17. Gross trade requirement		$\hat{GTR}_t$
18. Special Fuggle allotment		SFA_t
19. Balance		$\hat{GTR}$-SFA_t
20. Potential available not produced		$\hat{PANP}_t$
21. Salable quantity		$\hat{SQ}_t$
22. Salable percentage computed		$\hat{SPC}_t$
23. Salable percentage recommended		$\hat{SPRC}_t$

[a]The HAB also makes projections and suggestions to the HAC. The HAC makes the final decision on the salable percent that is recommended to the U.S. Secretary of Agriculture.

[b]Quantity of hops produced that is available to the market under that year's salable percent.

[c]All projections are indicated as such by a hat (^) above them.

[d]Demand components are estimated for both fresh hops and hop extract. Extract is based on ratio of pounds of fresh hops to 1 pound of hop extract. In this research the total demand components (fresh plus extract) were used.

[e]Includes other minor uses and year-end statistical adjustments.

[f]Pounds of hops the HAC/HAB deems necessary to maintain orderly marketing conditions in future years.

For example, when the $\hat{GTR}_t$ is increased over the last marketing year, producers may not have planted enough to supply the expected salable quantity.[14] Therefore, $\hat{PANP}_t$ is a result of producers not having the capacity to produce their full allotment and is an adjustment that helps insure that the $\hat{GTR}_t$ will be filled. Other adjustments are made for past trends in such factors as weather, disease, winter kill, drought, as well as of growers not producing their full allotment base.

The salable quantity ($\hat{SQ}_t$) is finally computed as:

$$[5] \quad \hat{SQ}_t = \hat{GTR}_t - SFA_t + \hat{PANP}_t$$

The $\hat{SQ}_t$ is then converted to "salable percent computed" ($\hat{SPC}_t$) by dividing it by the base as established in 1966 of 59,270,000 pounds:

$$[6] \quad \hat{SPC} = \hat{SQ}_t / 59{,}270{,}000$$

If special conditions warrant further consideration, the $\hat{SPC}_t$ can be changed before it is recommended to the U.S. Secretary of Agriculture for approval. If no such adjustment occurs, then the $\hat{SPC}_t$ is the salable percent that is recommended ($\hat{SPRC}_t$) to the Secretary of Agriculture. The salable percent recommended is the proportion of the 1966 base quantity of hops the HAC deems necessary to supply to the market in order to maintain orderly marketing conditions in marketing year t.

The marketing order for hops has not eliminated the cycle in hop acreage (figure 3). The cycle still occurs, but with apparently longer duration. The decline in acreage from 1965 to 1970 encompasses 5 years, the rise in 1970 to 1974 included 4 years, the decline from 1974 to 1979 spanned 5 years.

The hop price (annual average) at the farm level is also shown in figure 3. Throughout the life of the current order the price (undeflated) has trended upward. To obtain information relevant to determine whether the order has

[14]Establishment of new hop yards require time and large amounts of capital. Also, baby hops (hops planted in the spring) do not yield a full crop the first year.

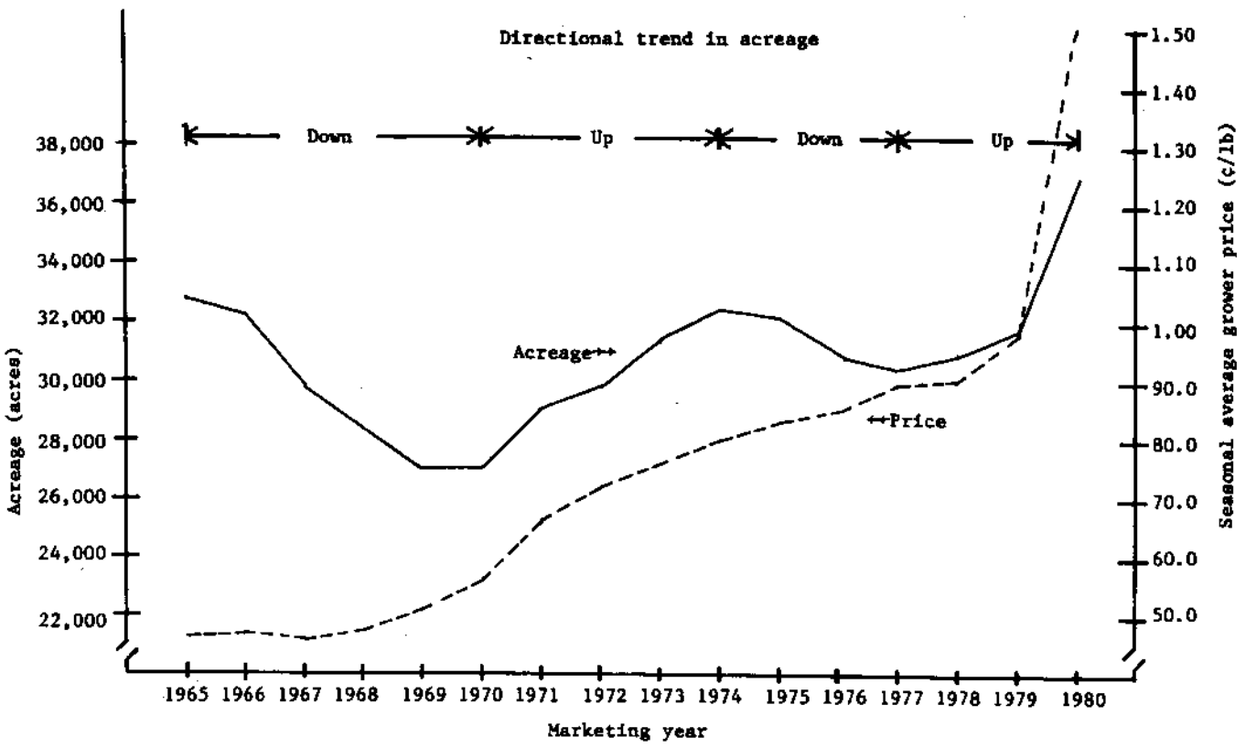

Figure 3. U.S. hop acreage and average seasonal grower prices, 1965-80.

brought about a more orderly marketing program in terms of price, the mean, standard deviation, and coefficient of variation of price were computed for the time period 1966-80. The mean price for that time period was 75.5 cents per pound, the standard deviation was 27.06, and the coefficient of variation was 35.84%. In comparison to the statistics reported in table 1, the order appears to have stabilized prices to the producers since there was a noticeable reduction in the relative variability of the seasonal average prices received during the period the marketing order was operating.

The average seasonal price of $1.50 per pound in 1980 was primarily a result of a crop failure in some of the major hop producing areas of Europe. Thus, this extremely high price cannot be attributed entirely to the marketing order. If the 1980 price is not included in the series, the mean price is 68.05 cents per pound, the standard deviation is 17.07, and the coefficient of variation is 25.1%. Overall, the current marketing order appears to have resulted in a more stable price to hop growers over time than occurred previously.

HAC Behavior Patterns

Comparison of HAC Projections with Actual Market Values

This section analyzes actual industry data as compared to the projections of that data made by the HAC at the annual marketing policy meetings. The purpose of this analysis is to ascertain whether the actions of the HAC have reduced or restricted the quantity of hops made available to the market as opposed to having supply in reasonable balance with demand. The data used covered the time period of 1969-78 for year t-1 and 1969-79 for year t. These statistical measures used to compare the projections with the actual market outcomes included: (1) the means of the actual and projected data sets, (2) the standard deviations of both data sets, (3) the coefficients of variation, (4) the correlation coefficients between the actual and projections, (5) the mean percent errors, and (6) the mean absolute percent errors (table 7).

The means of projected exports in t-1 and brewery consumption in both t and t-1 were greater than the means of the actual market results. The means of the HAC projections of competing supply component in t, namely imports, was less than the means of actual market results. The projected carryouts were on the average less than the actual carryouts. These results indicate that the HAC, on the average, has historically projected a stronger market situation in terms of both larger demands and smaller competing supplies, than what has actually occurred. This behavior of the HAC

Table 7. Statistical comparison of actual U.S. hop industry market statistics to HAC projections.

Component/Year	Years	Mean	Standard deviation	Coeff of variation	Projected versus actual: Correlation coefficient	Projected versus actual: Mean % error	Projected versus actual: Mean absolute % error
Marketing year t-1							
Imports:							
Projected	1969-1978	12,104	955	7.89	0.72	1.08	6.00
Actual	1969-1978	12,315	1,463	11.88			
Brewery consumption:							
Projected	1969-1978	35,546	1,788	5.03	0.68	−0.94	3.56
Actual	1969-1978	35,271	2,241	6.35			
Exports:							
Projected	1969-1978	27,100	3,821	14.10	0.64	−2.04	11.49
Actual	1969-1978	26,800	4,103	15.31			
Marketing year t							
Imports:							
Projected	1969-1979	11,632	1,291	11.10	0.39	7.33	10.52
Actual	1969-1979	12,721	1,933	15.19			
Brewery consumption:							
Projected	1969-1979	36,341	2,026	5.57	0.26	−2.15	6.88
Actual	1969-1979	35,757	3,046	8.52			
Exports:							
Projected	1969-1979	26,591	3,917	14.73	0.15	2.50	17.14
Actual	1969-1979	28,158	5,593	21.14			
Carryouts:							
Projected	1969-1979	33,409	10,507	31.5	0.46	10.20	23.37
Actual	1969-1979	37,673	8,629	22.9			

indicates a tendency to be overly optimistic with regard to the outlook of the hop market.

The standard deviations of projected variables were less than the standard deviations of actual market data except for carryouts. This would suggest that the HAC's projections of the supply and demand components appear to be less variable than the actual market outcomes in the U.S. hop industry.

The standard deviations of all projections in t-1 were less than those of projections in t. This result is a reflection of the added uncertainty associated with projections for marketing year t, since the HAC has actual market data available for the first portion of the t-1 marketing year at the time of the policy meeting, but has no actual market data available for marketing year t.

The simple correlations between the actual and projected values are much higher for projections in marketing year t-1 variables than for projections associated with marketing year t. This again results from the fact that some market data for the first months of t-1 are available to the HAC at the time of the policy meeting. The stock of knowledge upon which projected values for t-1 are based is more complete than for t.

Mean percent errors and mean absolute percent errors were employed to measure the average error of the projections from the actual data. Imports were underestimated by an average of 1.08% for marketing year t-1 and 7.33% for marketing year t projections as indicated by the mean percent errors. These errors are quite low when taking into consideration the volatile nature of imports.

Carryouts in marketing year t were generally underestimated by an average of 10.2%. The mean percent error of the HAC export projections indicate that they were, on the average, overestimated by 2.04% for marketing year t-1 and underestimated by 2.50% for marketing year t. Brewery consumption was overestimated by an average of .94% for marketing year t-1 and 2.15% for marketing year T. These mean percent errors reinforce the conclusions drawn earlier concerning the optimistic posture of the HAC.

The projection errors were higher for marketing year t than for marketing year t-1 projections. This was especially true for exports and carryouts. A major reason carryout projections exhibit such a high degree of error is because carryouts function as a buffer in the system. Whenever any major component of demand or supply deviate from an expected value, the gain or loss appears in carryout. For example, if U.S. hop growers experienced a crop failure, the majority of the shock will appear in a smaller carryout for that year.

Overall, the HAC appears to be overly optimistic in projecting demand components and less optimistic or even pessimistic in projecting competing supply components. This behavior pattern would suggest that the HAC did not attempt to restrict the flow of hops to the market. In fact, the salable percentage recommendations were overly optimistic given the

Table 8. Structure of the U.S. hop model.

Equation	Specification
1	$IM_{t-1} = f_1(IM_{t-1}, IM_{t-2}, I_{t-1})$
2	$TS_{t-1} = IM_{t-1} + CI_{t-1} + SPR_{t-1}$
3	$BC_{t-1} = f_2(BC_{t-1}, BC_{t-2})$
4	$EX_{t-1} = f_3(EX_{t-2}, I_{t-1}, T_t$
5	$TND_{t-1} = BC_{t-1} + EX_{t-1} + BI_{t-1}$
6	$CI_t = TS_{t-1} - TND_{t-1}$
7	$IM_t = f_4(IM_{t-1}, HPR_{t-1}, T_t$
8	$TNS_t = CI_t + IM_t$
9	$BC_t = f_5(BC_{t-1}, T_t, BC_{t-2})$
10	$EX_t = f_6(EX_{t-1}, HPR_{t-1}, BS_{t-1})$
11	$CO_t = f_7(BS_{t-1})$
12	$TD_t = BC_t + EX_t + CO_t + BI_t$
13	$SP_t = (TD - TNS_t - SFA_t + PANP_t)/592.7$

projected supply and demand situations, and the implied volume of hops would not necessarily lead to undue price enhancement.

Structural Model

In order to further analyze the reactions of the HAC to various supply and demand stimuli, a structural model was specified to approximate and simulate the process the HAC utilizes in establishing the salable percentage each marketing year. The model specification closely parallels the process through which the salable percentage is determined as described above. The choice of explanatory variables used to model the HAC projection process was based on those indicated by HAC members as important factors in making projections (see previous discussion of HAC/HAB meetings). Final equation specifications were determined by data availability as well as goodness of fit and a priori reasonableness considerations.

The structural model contains 13 equations. Each supply and demand component for which a projection is made at the marketing policy meeting of the HAC is presented as a separate structural equation (tables 8 and 9). There are seven behavioral or predictive equations contained within the model. The other six equations are identities. The reader should note that BI_t, BI_{t-1}, SFA_t, and $PANP_t$ were treated exogenously, primarily because they are very minor components of the total quantity of hops dealt with in an ordinary marketing year.

In most models related to agriculture, one would expect to observe price as a variable. Price generally plays a paramount role in the equating of supply and demand. Price was not included as an explanatory force in this model. The HAC in establishing an orderly marketing program is not supposed to take directly into account the price level of hops in setting the salable percentage, but only react to supply and demand components and the needs of the market. The charge of the HAC is to make available a quantity of hops sufficient to facilitate an orderly marketing program and to capture an increasing fraction of the domestic and foreign markets. Thus, price is not to be a factor directly affecting the HAC decision process.

The time series data on HAC projections and actual market data from 1969 to 1978 were used to estimate the parameters of the model. The statistical results for each structural equation are reported in table 10.

The results of OLS estimates of the parameters are accompanied by selected statistical measures. The calculated t-values used to test each parameter estimate for statistical significance are given in parentheses directly below the corresponding coefficient. The standard error of estimate ($S_{y.x}$), the standard deviation of the dependent variable (S_y), the coefficient of determination (R^2), a calculated F-value (F) for testing the null hypothesis that all regressors have zero coefficients, and the Durbin-Watson statistic (D.W.) test for autocorrelation are reported.

All of the coefficient signs, t-values, and other statistical measures appeared acceptable on an economic and/or statistical basis. Only four t-values were less than 2.00 in absolute value. All of the t-values, however, were greater than 1.00 in absolute value, and since the signs associated with the coefficients were acceptable on an economic basis, these variables were left in the equations.

To measure the goodness of fit of the structural model to the historical data set of actual HAC predictions, the model was solved for each of the current endogenous variables via the Gauss-Seidel technique for the time period of 1971-79 which were years common to all the structural equations. In the process of this evaluation, four measures of goodness of fit were computed for each of the 13 variables (table 11).

The mean percent error expresses the value of each error as a percentage of the actual value of the variable. These percentages are then averaged to determine a mean percent error. The low values of this statistic are a partial indication of the extremely good fit of the model to historical data.

The absolute value of each forecast error is expressed as a percentage of the actual absolute value of the variable, and these percentages are averaged to determine a mean absolute percent error. In all

Table 9. Symbolic names and definitions of variables used in constructing the U.S. hop model.

Symbolic names of variables	Definitions	Symbolic names of variables	Definitions
$\widehat{IM}_{t-1}$	Projected imports during marketing year t-1 (1,000 lb)	$\widehat{CI}_t$	Projected beginning inventory for marketing year t (1,000 lb)
$IM_{t-1}^{9,10}$	Known imports during September and October of marketing year t-1 (1,000 lb)	$\widehat{IM}_t$	Projected imports during marketing year t (1,000 lb)
IM_{t-2}	Known imports during marketing year t-2 (1,000 lb)	$HPR_{t-1}^{U.S.}$	Known U.S. hop production during marketing year t-1 (1,000 lb)
$I_{t-1}^{11/1}$	Known total hop stocks on November 1 of marketing year t-1 (1,000 lb)	$\widehat{TNS}_t$	Projected total net supply during marketing year t (1,000 lb); salable quantity is not included
$\widehat{TS}_{t-1}$	Projected total supply of hops during marketing year t-1 (1,000 lb)	$\widehat{BC}_t$	Projected brewery consumption in marketing year t (1,000 lb)
CI_{t-1}	Known beginning inventory of hops for marketing year t-1 (1,000 lb), includes hops held by growers, dealers, and brewers	$\widehat{EX}_t$	Projected exports of U.S. hops during marketing year t (1,000 lb)
SPR_{t-1}	Known salable production of hops for marketing year t-1 (1,000 lb); the SPR_{t-1} is the quantity of hops produced in t-1 and available to the market under the t-1 salable percentage	BS_{t-1}	Known brewery stocks on September 1 of marketing year t-1 (1,000 lb)
$\widehat{BC}_{t-1}$	Projected brewery consumption during marketing year t-1 (1,000 lb)	$\widehat{CO}_t$	Projected ending inventory during marketing year t (1,000 lb)
$BC_{t-1}^{9,10}$	Known brewery consumption during September and October of marketing year t-1 (1,000 lb)	$\widehat{TD}_t$	Projected total demand for U.S. hops during marketing year t (1,000 lb)
BC_{t-2}	Known brewery consumption during marketing year t-2 (1,000 lb)	BI_t	Balancing item during marketing year t (1,000 lb); BI_t is treated as an exogenously determined variable
$\widehat{EX}_{t-1}$	Projected exports of U.S. hops during marketing year t-1 (1,000 lb)	SFA_t	Special allotments in marketing year t (1,000 lb); SA_t is treated as an exogenously determined variable
EX_{t-2}	Known exports of U.S. hops during marketing year t-2 (1,000 lb)	$PANP_t$	Potential available not produced in marketing year t (1,000 lb); allocated base that will be available to market; $PANP_t$ is treated as an exogenously determined variable
T_t	Last two digits of the first year included in the marketing year (69, 70, . . .)	$\widehat{SP}_t$	Salable percentage for year t; computed as a percentage of the salable base (59,270,000 lb) as established in 1966.
$\widehat{TND}_{t-1}$	Projected total net demand for hops in marketing year t-1 (1,000 lb)		
BI_{t-1}	Balancing item during marketing year t-1 (1,000 lb); BI_{t-1} is treated as an exogenously determined variable		

equations of the model, the mean absolute percent errors are 7.1% or less. The foreign trade, carryout, and salable percentage equations generally exhibited larger errors. Because the model is recursive, the error observed in the salable percentage equation can be interpreted as a reflection of errors present in projections that compose the identity.

The squared correlation between actual and solution values was another measure of goodness of fit for the model. The lowest squared correlations were observed on the salable percentage. Overall, the rest of the squared correlation coefficients are 0.76 or greater.

The last measure, Theil-U_2 statistic, measures the quality of the model as it forecasts turning points. The closer to zero, the better the fit. The computed values for each equation were all below 1.0 with the exception of the salable percentage equation which has a value of 1.06.

Overall, the structural model appears to have approximated the behavior of the HAC fairly well in its projecting of various supply and demand components in marketing years t-1 and t. The model had the general tendency to have a greater degree of error associated with (1) the projections in marketing year t as compared to t-1, and (2) the projections involving foreign trade components as compared to domestic supply and demand components. It is not possible to compare the results in tables 7 and 11 in terms of the HAC being excessively optimistic or pessimistic about future demand and supply components. The statistics in table 7 compare actual market statistics to HAC projections, while table 11 contains statistics which compare the values generated by the structural model to the HAC's projections.

Table 10. Estimated structural model of the HAC decision process concerning the annual salable percentage.

Equation 1: Imports in t-1

$$\widehat{IM}_{t-1} = 6{,}429.746 + 9.1771IM_{t-1} + 0.752IM_{t-2} - 0.5111_{t1}^{11/1}$$
$$(3.37) \quad (3.64) \quad (6.03) \quad (-4.41)$$

$S_{y.x} = 351.36$ thousand pounds
$S_y = 987.9$ thousand pounds
$R^2 = .92$ $F = 19.41$ D.W. $= 2.67$
Data Set: 1971-1979

Equation 2: Total supply in t-1

$$\widehat{TS}_{t-1} = \widehat{IM}_{t-1} + CI_{t-1} + SPR_{t-1}$$

Equation 3: Brewery consumption in t-1

$$\widehat{BC}_{t-1} = 2{,}721.067 + 2.469BC_{t-1}^{9\text{-}10} + 0.558BC_{t-2}$$
$$(0.61) \quad (4.27) \quad (3.90)$$

$S_{y.x} = 565.25$ thousand pounds
$S_y = 1{,}647.81$ thousand pounds
$R^2 = .91$ $F = 30.99$ D.W. $= 1.80$
Data Set: 1971-1979

Equation 4: Exports in t-1

$$\widehat{EX}_{t-1} = 41{,}720.35 + 0.683EX_{t-2} + 0.207I_{t-1}^{11\text{-}1} - 650.603T_t$$
$$(1.17) \quad (3.38) \quad (1.30) \quad (-1.20)$$

$S_{y.x} = 2{,}063.5$ thousand pounds
$S_y = 3{,}355.14$ thousand pounds
$R^2 = .76$ $F = 5.38$ D.W. $= 2.69$
Data Set: 1971-1979

Equation 5: Total net demand in t-1

$$\widehat{TND}_{t-1} = \widehat{BC}_{t-1} + \widehat{EX}_{t-1} + BI_{t-1}$$

Equation 6: Carryin in t

$$\widehat{CI}_t = \widehat{TS}_{t-1} - \widehat{TND}_{t-1}$$

Equation 7: Imports in t

$$\widehat{IM}_t = -11{,}936.04 + 0.936\widehat{IM}_{t-1} - 0.495HPR_{t-1}^{\Gamma,8} +$$
$$(-0.66) \quad (2.05) \quad (-3.40)$$
$$516.279T_t$$
$$(2.00)$$

$S_{y.x} = 814.64$ thousand pounds
$S_y = 1{,}346.29$ thousand pounds
$R^2 = .77$ $F = 5.62$ D.W. $= 2.55$
Data Set: 1971-1979

Equation 8: Total net supply in t

$$\widehat{TNS}_t = \widehat{CI}_t + \widehat{IM}_t$$

Equation 9: Brewery consumption in t

$$\widehat{BC}_t = 4{,}609.645 + 0.913\widehat{BC}_{t-1} - 112.045T_t + 0.229BC_{t-2}$$
$$(1.24) \quad (7.25) \quad (-2.08) \quad (1.51)$$

$S_{y.x} = 328.60$ thousand pounds
$S_y = 1{,}750.0$ thousand pounds
$R^2 = .98$ $F = 73.97$ D.W. $= 1.89$
Data Set: 1971-1979

Equation 10: Exports in t

$$\widehat{EX}_t = -2{,}594.302 + 0.851\widehat{EX}_{t-1} + 0.163HPR_{t-1}^{\Gamma,8} -$$
$$(-1.13) \quad (10.38) \quad (2.18)$$
$$0.054BS_{t-1}$$
$$(-1.73)$$

$S_{y.x} = 628.14$ thousand pounds
$S_y = 3{,}725.29$ thousand pounds
$R^2 = .98$ $F = 10.52$ D.W. $= 2.84$
Data Set: 1970-1979

Equation 11: Carryouts in t

$$\widehat{CO}_t = -1{,}446.595 + 1.026BS_{t-1}$$
$$(-0.34) \quad (8.76)$$

$S_{y.x} = 3{,}269.75$ thousand pounds
$S_y = 10{,}034.0$ thousand pounds
$R^2 = .91$ $F = 76.75$ D.W. $= 2.80$
Data Set: 1970-1979

Equation 12: Total demand in t

$$\widehat{TD}_t = \widehat{BC}_t + \widehat{EX}_t + \widehat{CO}_t + BI_t$$

Equation 13: Salable percentage in t

$$\widehat{SP}_t = (\widehat{TD}_t - \widehat{TNS}_t - SFA_t + PANP_t)/59{,}270{,}000 \text{ pounds}$$

Table 11. Measures of goodness of fit for the U.S. hop model, 1971-79.

Current Endogenous variable (Y)	Mean % error	Mean absolute % error	Y vs. Y squared correlation*	Theil-U_2 statistic
IM_{t-1}	–0.19976	1.94124	0.92092	0.44418
TS_{t-1}	–0.04700	0.20174	0.99948	0.07399
BC_{t-1}	0.01588	1.11717	0.91137	0.30070
EX_{t-1}	–0.46314	5.19079	0.76352	0.64878
TND_{t-1}	–0.04952	1.94161	0.80745	0.81791
CI_{t-1}	–0.29195	3.47560	0.97644	0.49978
IM_t	–0.37606	4.37919	0.76789	0.71935
TNS_t	–0.22588	2.17379	0.97931	0.42897
BC_t	0.02036	1.14105	0.90793	0.28662
EX_t	–0.53852	3.88628	0.81322	0.61447
CO_t	–0.26851	6.33345	0.89050	0.73302
TD_t	–0.03234	2.75268	0.87514	0.82270
SP_t	–0.61594	7.13396	0.41969	1.06313

*The squared correlation coefficient for IM_t, BC_t, EX_t differ from the reported R^2 for the same structural equations. The solution values for current endogenous variables (IM_{t-1}, BC_{t-1}, and EX_{t-1}) which appear before these equations in the recursive model were used as the right-hand side values in finding the solution values for IM_t, BC_t, and EX_t. The actual values of these variables were used in the estimation of the structural parameters and the calculation of the R^2's. The CO_t equation difference arises because one more observation (1970) was used in the estimation of the structural equation parameters than was used in measuring the goodness of fit for the entire model.

Impact Multipliers

Impact multipliers were used to estimate the impacts of changes in the exogenous variables or the factors which influence the HAC's projections in the structural model on each of the endogenous variables representing an HAC projection (table 12). On the left-hand side of table 12, each current endogenous variable (i.e., the supply or demand component projected by the HAC) is labeled by its symbolic name and its unit of measurement is indicated. The symbolic names of the predetermined factors which influenced the HAC behavior and the magnitude of a one-unit change in each variable, are presented across the top of the table. Each element in the table represents the impact of a one-unit change in one of the 15 predetermined variables on each endogenous variable, with all other variables held constant.

The impact multipliers appearing in the salable percentage row represent the impact of a one-unit change (for one time period) in each of the exogenous variables or the factors which influence the HAC's behavior. Overall, any increase (decrease) in total supply will have a negative (positive) impact on the salable percentage. Any increase (decrease) in total demand will have a positive (negative) impact on the salable percentage.

Identical multipliers (except for positive and negative signs) represent the effect that each of six exogenous variables have on the salable percentage. These coefficients are the same because they only appear in identities. A one-unit change in one of these variables will add or substract exactly one unit from the salable quantity. The CI_{t-1}, SPR_{t-1}, which are factors influencing the HAC's projections of the total supply in year t-1, and SA_t, which influences the calculation of the salable percentage, all have positive impacts on the total supply projection. A one-unit increase in any one of these factors results in a reduction of the salable percentage by .0017%. On the other hand, an increase in BI_{t-1}, BI_t, or $PANP_t$ of one unit will lead to an increase in the projection of total demand and, therefore, an increase in the salable percentage of .0017%. As evidenced by the impact multipliers on IM_{t-1}, the import variables (IM_{t-1} and IM_{t-2}) both have a positive impact on the total supply projection. Therefore, it is expected that both have a negative effect on the salable percentage.

The I_{t-1} variable impacts the projections of both a supply and demand component, and ultimately, the salable percentage. The cumulative impact of a 1,000 pound increase in I_{t-1} is to increase the salable percentage recommendation of the HAC by .0008%.

The multipliers associated with brewery consumption all have positive impacts on projected total demand and have a positive impact on the salable percentage recommendation. BC_{t-1} exhibited a larger impact on the salable percentage (.008) than BC_{t-2} (.0022).

EX_{t-2} has a positive impact on total demand projections. As the amount of exports increases, the projection of demand for domestically produced hops increases. This in turn leads to an increase in the salable percentage.

The HPR_{t-1} variable has a positive impact on the total demand projection as observed by the positive coefficient (.163) in the EX_t equation. As hop production in t-1 increases, the HAC expects exports in t to increase because of the greater availability of U.S. hops at a lower price, all other factors held constant.

HPR_{t-1} has a negative impact on the total supply variable, as observed by its

Table 12. Impact multipliers in the U.S. hop model.

Endogenous Variables			Exogenous Variables—Symbolic Name							
Equation Number	Symbolic Name	Unit	$IM_{t-1}^{9,10}$	IM_{t-2}	I_{t-1}^{11-1}	CI_{t-1}	SPR_{t-1}	$BC_{t-1}^{9,10}$	BC_{t-2}	EX_{t-2}
			(1,000 lb)							
1	$\widehat{IM}_{t-1}$	1,000 lb	9.177	.752	−.051	0	0	0	0	0
2	$\widehat{TS}_{t-1}$	1,000 lb	9.177	.752	−.051	1	1	0	0	0
3	$\widehat{BC}_{t-1}$	1,000 lb	0	0	0	0	0	2.469	.558	0
4	$\widehat{EX}_{t-1}$	1,000 lb	0	0	.207	0	0	0	0	.683
5	$\widehat{TND}_{t-1}$	1,000 lb	0	0	.207	0	0	2.469	.558	.683
6	$\widehat{CI}_t$	1,000 lb	9.177	.752	−.258	1	1	−2.469	−.558	−.683
7	$\widehat{IM}_t$	1,000 lb	8.5897	.7039	−.0477	0	0	0	0	0
8	$\widehat{TNS}_t$	1,000 lb	17.7667	1.4559	−.3057	1	1	−2.469	−.588	−.683
9	$\widehat{BC}_t$	1,000 lb	0	0	0	0	0	2.2542	.7385	0
10	$\widehat{EX}_t$	1,000 lb	0	0	.1762	0	0	0	0	.5812
11	$\widehat{CO}_t$	1,000 lb	0	0	0	0	0	0	0	0
12	$\widehat{TD}_t$	1,000 lb	0	0	.1762	0	0	2.2542	.7385	.5812
13	$\widehat{SP}_t$	1%	−.03	−.0025	.0008	−.0017	−.0017	.008	.0022	.0021

Endogenous Variables			Exogenous Variables—Symbolic Name						
Equation Number	Symbolic Name	Unit	T	BI_{t-1}	HPR_{t-1}	BI_t	FA_t	$PANP_t$	BS_{t-1}
			(1 yr)			(1,000 lb)			
1	$\widehat{IM}_{t-1}$	1,000 lb	0	0	0	0	0	0	0
2	$\widehat{TS}_{t-1}$	1,000 lb	0	0	0	0	0	0	0
3	$\widehat{BC}_{t-1}$	1,000 lb	0	0	0	0	0	0	0
4	$\widehat{EX}_{t-1}$	1,000 lb	−650.603	0	0	0	0	0	0
5	$\widehat{TND}_{t-1}$	1,000 lb	−650.603	1	0	0	0	0	0
6	$\widehat{CI}_t$	1,000 lb	650.603	−1	0	0	0	0	0
7	$\widehat{IM}_t$	1,000 lb	516.279	0	−.495	0	0	0	0
8	$\widehat{TNS}_t$	1,000 lb	1,166.882	−1	−.495	0	0	0	0
9	$\widehat{BC}_t$	1,000 lb	112.045	0	0	0	0	0	0
10	$\widehat{EX}_t$	1,000 lb	−553.6632	0	.163	0	0	0	−.054
11	$\widehat{CO}_t$	1,000 lb	0	0	0	0	0	0	1.026
12	$\widehat{TD}_t$	1,000 lb	−665.7082	0	.163	0	0	0	.972
13	$\widehat{SP}_t$	1%	−3.0919	.0017	.0011	.0017	−.0017	.0017	.0016

negative coefficient (–.495) in the $\hat{IM}_t$ equation. As U.S. hop production increases in year t-1, it is expected that fewer hops will be imported into the United States in year t. Therefore, the total net supply variable (no accounting for U.S. production in year t) projected will decrease in marketing year t.

In the $\hat{EX}_t$ and $\hat{IM}_t$ projections, the HPR_{t-1} factor acts to stimulate the anticipated need for U.S. hops. The combined effect of a 1,000 pound production increase in exports is to increase the final salable percentage recommendation by .0011%.

Brewery stocks in t-1 have two opposing influences upon the salable percentage decision. BS_{t-1} has both a positive and a negative impact on the total demand projection. First, the positive coefficient in the $\hat{CO}_t$ equation indicates that an increase in BS_{t-1} leads to an increase in the projection of desirable carryouts in t, and therefore, in total demand. The negative coefficient on BS_{t-1} in the $\hat{EX}_t$ equation indicates a negative impact on projected exports, and therefore, on total demand. When both impacts described above are taken into account in the model, the cumulative impact of BS_{t-1} on the salable percentage recommendation is positive. A 1,000 pound increase in BS_{t-1} will lead to a .0016% increase in the salable percentage recommendation.

Summary

From 1966 on, Federal Marketing Order No. 991 has been in effect. The order contains a volume control provision that limits the quantity of hops marketed from current production and, at the same time, discourages overproduction or underproduction. Marketing Order No. 991 includes quality control, research and development, volume limitation, and reserve pool provisions. An empirical analysis of the comparison of HAC projected components of supply and demand to actual market results was conducted. The analysis revealed that on the average, the committee overestimated demand components and underestimated supply components. The HAC can best be described as being overly optimistic in their decision process (projections), and placing on the market a larger quantity than needed if they had perfect knowledge and were able to project all supply and demand components with complete accuracy. As a result, it can be partially concluded that the HAC has not unduly used its market power in restricting the quantity of hops available to the market from domestic production. The actions of the HAC appear to have developed an orderly marketing program for hops. The degree of price variability during the life of the present order has been less than half that experienced otherwise.

The specification of a structural model of the HAC behavior was drawn directly from the policy worksheet used by the HAC. The parameters of the seven behavioral equations which represent the projections made by the HAC were estimated via OLS. Six identity equations were needed to complete the model. All 13 equations were arranged so that they were linked in a manner that approximated the volume limitation decision process of the HAC.

The matrix of impact multipliers was computed from the structural model. Results of the impact multiplier analysis indicated that the larger negative impacts on the salable percentage recommendation arose from consideration of import variables. Of the factors that resulted in a positive impact on the salable percentage recommendation by the HAC, brewery consumption had the largest impact.

Brewery stocks are very closely watched by the HAC in its decision process. Within the model, it had a negative impact on the export level projections and a positive impact on the carryout projections. The net impact of an increase in brewery stocks was to influence the salable percentage recommendations positively since the total demand is increased.

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